

The four female figures holding the emblems of the *Nag* (hooded serpent) the *Pudma* (lotus), the *Gadha* (mace), and the *Trisool*, (trident), represent *Sakhis*, or attendants. The two upper figures represented as flying with cornucopiæ and wreaths in their hands, are probably intended for bearers of offerings, and called *Powri*, but have no other purpose or meaning than for ornament to the entire piece of sculpture; such additions were entirely at the discretion of the sculptor.

The idol is about three by one-half feet (every part inclusive,) and is worked in black chlorite; it is exceedingly well executed, the jewels and the embroidery on the drapery are most exquisitely cut, and the *tout ensemble* may be pronounced a beautiful specimen of Hindú sculpture.

M. KITTOE.

ART. V.—*Papers relative to the New Coal Field of Tenasserim.*

No. 1.—*Report on the Coal Field at Ta-thay-yna, on the Tenasserim river, in Mergui province. By J. W. HELFER, M. D.*

This newly discovered coal field is a part of that great coal deposit which occupies a considerable part of the Tenasserim district, in Mergui province, and which beginning from the old town of Tenasserim, to judge from geognostic appearances, extends about forty miles to the north, about fifty towards the south-east, and to an unknown extent towards the north-east.

All this tract of country seems to be a great basin encircled by primitive, but much more transition, formations, which in isolated ranges emerge also in different parts of this basin, but which are easily traced and recognized as the offsets of their more distant relations.

The present coal field lies at the southern skirt of one of these transition ranges, and the country to the south of it is apparently a great plain, densely covered either with tall forests or bamboo jungle; the Tenasserim river winds through this plain in a direction chiefly from north to south.

In the neighborhood of the present locality no geognostic signs of the existence of a coal bed are to be observed on the river side, save opposite to the village there is a large lump of a formation holding the medium between red sandstone, variegated sandstone, and slate clay—in this country a certain prognostication of the vicinity of coals. The river banks shew besides sandstone, conglomerate, plastic clay, marl, and alluvium; the upper stratum, of a thickness from fifteen to thirty feet, is almost universally tinged

red or ochry, by the abundance of iron oxyde with which it is impregnated.

The coal is visible either in its native locality on the side of a monsoon rivulet, or is to be found in pieces in the bed of the same rivulet.

This deposit is neither covered with porphyry, nor red sandstone, nor arenaceous beds belonging to intermediary formations; above it are only placed alternating beds of slate clay, either bluish grey or whitish, either friable or compact, and then carburetted Brand-striefer, and these strata taken altogether are not more than three and a half feet in thickness, above which rest the above mentioned iron-tinged earthy clay and alluvium. At this place the coal may be calculated to be seventeen feet below the surface on an average.

On the sides of this rivulet or channel, dug out by the impetus of the water, a section is exposed of fifty-four feet in length, and the same formation is traceable more than one mile to the north, and six west.

The thickness of this coal stratum is as yet not ascertained, on account of the water accumulating in the rivulet, the rainy season having begun; but it must be considerable, as at a depth of six feet no other alternating formation has been found. In consequence of this the nature of the sub-stratum cannot be yet determined.

This stratum runs nearly in a direct line from north to south, and dips under an angle of 26° east to the horizon. In two places it is contracted, in the rest uniform.

It is difficult to classify exactly this coal, on account of its modifications in different pieces. It belongs to the sub-genus black coal, but there are several species even in the seven tons which have hitherto been brought to light.

Some pieces participate greatly of the character of Cannel-coal, these having a resinous lustre and a flat conchoidal fracture; the pieces nearer to the surface have again more of the character of slaty coal, with a slaty fracture, fragments trapezoidal; the greatest number, however, hitherto observed refer it to glance coal, sub-species pitch coal, being massive, in botryoidal loam, with a woody texture, fracture large, perfectly conchoidal, fragments sharp-edged, undetermined angular. The dendritic texture is a peculiar feature of this coal, not observed in any of the other coal species hitherto found in the Tenasserim provinces.

A hundred grains of the coal previously reduced to small pieces were placed upon a platina sheet, and put over a lamp fed with alcohol; on becoming red hot, they baked slightly together, and on being removed from the fire assumed an iron grey co-

lour; one hour and six minutes elapsed before the hundred grains were totally consumed, the residuum was greyish ashes—from 100 parts 2·8 remained of them. The ashes subjected to chemical analysis were found to consist of *silica* and *alumina*, with scarcely a vestige of iron.

1. Generally speaking the coal is very good; but one great defect cannot be concealed, and this is, that some parts of it are highly pyritiferous, the pyrites intersecting it in thin laminæ of a silver-white, somewhat yellowish colour. Fortunately only some parts are thus deteriorated, but even these it is to be hoped will not be lost, as the thin layers of pyrites are easily separated; that part of the coal which cannot be conveniently rendered destitute of this bi-sulphuret of iron ought to be rejected, which necessary selection will have an influence, perhaps materially, upon the price of the coal.

We can at present speak only of the coal near to the surface and exposed partially to atmospheric influence, but it is to be hoped that the coal will be much purer the farther it is from the surface.

2. The pure coal (free from pyrites) burns freely and open; transformed into coke it bakes a little together. It emits in the beginning copious flames, which are blackish grey, and unmixed with sulphuric vapours.

General results. *a.* That the coke of this coal is well adapted for smithy purposes.

b. That the coal (excepting always the pyritiferous strata, especially near to the surface) is remarkably pure, and fit to burn as fuel in chimneys.

c. That the coal consumes slowly, maintains a considerable degree of heat, and leaves a residuum of only three per cent at the highest, and that it is therefore adapted for steam purposes.

d. That it is inferior to the Cannel coal on the little Tenasserim for the generation of gas, on account of the smaller per centage of bitumen.

The locality for transport is very favourable; and the greatest advantage consists in the almost total absence of land carriage.*

The present coal field lies on the western side of the Tenasserim, 1712 paces following the road, and probably not more than 400 fathoms in a straight line from the river.

The Tenasserim notwithstanding its long course, continues to be a mountain stream even when already under the influence of the tides. As such it has a rapid current, numerous shallows, annually changing banks, and shifting shoals. During the dry season it is at the place

* Sic in M.S.—Eds.

the nearest for the embarkation of the coals impracticable for boats drawing more than seventeen inches ; in this part of the river the coals will therefore probably be transported upon rafts of bamboos. After the confluence of the higher and lesser Tenasserim the river increases considerably in depth.

Captain R. Lloyd surveying the lower part of the river last year, was of opinion that vessels of 100 tons burthen might go up to Tenasserim town, but thinks it advisable to employ only vessels of a much smaller size.

It is very probable, judging from the formations, that the same field extends some twenty miles lower down the river, and that beds may be found still nearer the banks of the river ; but under present circumstances the transport twenty miles more or less *by water* is scarcely of any consequence ; experimental researches therefore would, besides being very expensive, prove precarious.

The existing formations (as far as they are known) to the west, and those in a parallel line on the sea-coast, preclude the hope of coal being found there.

Last year, in, March, when I first visited the banks of the Tenasserim, I was struck, in coming to its lower part, with the sudden change of the geognostic features of the country. The river instead of running for many miles through a mountainous country, its narrow bed inclosed between piles of granular talcose limestone, graywacke, greenstone, and transition porphyry, burst at once into an open country, the ridges of the above mentioned formations receding on both sides, and I found what I had missed for a long time—secondary formations ; and what I desired the most—formations belonging to the great independent coal deposits. Having given up all hope of finding coal in the parts of the Tenasserim provinces hitherto visited, I was at once animated with strong hope of success at the sight of these promising features.

The consequence proved this time, in a conspicuous manner, the truth and exactness of geognostic principles, and I found successively three localities of coal, mentioned in my last year's report sub : N. A. B. A. C. of which specimens were sent up to Calcutta. However the coal then found was all of indifferent quality, and, besides, not favourably situated ; the excellent coal discovered afterwards on the little Tenasserim belongs to quite a different system.

Convinced however of the existence of coal over a wide extent of that district, in fact expecting that the above mentioned plain through which the Tenasserim runs is a segment of a great coal basin, I

stimulated the Careans, the only inhabitants of that part of the country, to be assiduous in finding coal. I gave them samples of that mineral, which scarcely any one of them had seen before, and taught them to look for it in the beds of mountain torrents, on steep banks of rapid rivers, on parts of mountains or hills detached by the violence of the monsoon, &c., for they had generally imbibed the erroneous opinion that coal is only found on the summits of high mountains which formerly were in a state of combustion, and that coal is a species of cooled lava.

Fearing however that their natural apathy might prevent them from any exertion, I promised a reward of 50 Rs. to be given to any body who found coal of good quality not far from a river.

By a rather extraordinary coincidence, the present coal was found but a thousand yards distant from the place where I made the promise of the reward, and in the same village, the inhabitants of which accompanied me for three days in search after coal in the surrounding jungles.

A Carean of that village of the name of Ka-pho, penetrating two months and a half ago the thick forests in search of good ground for a plantation, came upon a small rivulet, and found coal partly at its bottom, partly protruding from its banks.

My lesson, but much more, undoubtedly, the prospect of the Fifty Rupees' reward, seemed not to have been forgotten. He took some pieces home, and kept them hidden for several weeks, not knowing if they were really coal, for the pieces which I distributed among the Careans were Burdwan coal of a different aspect. He consulted a friend afterwards, who advised him to go to Mergui and show the coal to me, but being apprized that I was absent (examining the Mergui Archipelago) the visit to Mergui was postponed. About a month afterwards a Burmese, of the name of Kho-baik, saw the specimens of coal by accident in a basket; he possessed himself of a piece, and hastened with it to Mergui to claim the reward for himself; he shewed it to the Assistant of the Commissioner in Mergui, and in this way the coal was brought to public notice.

(Signed)

J. W. HELFER, M. D.

MERGUI, 9th May, 1839.

No. 2.—*Report on the new Tenasserim Coal Field.*—By LIEUT. HUTCHINSON, *Madras Artillery.*

To E. A. BLUNDELL, Esq. *Commissioner, Tenasserim Provinces.*

SIR,—Having visited the coal field lately discovered upon the large branch of the Tenasserim river, I do myself the honor to forward a Chart of the river from the Coal to Mergui, and beg to offer some remarks for your consideration.

The coal is situated in north lat. $12^{\circ} 21' 30''$, and longitude about $99^{\circ} 5'$ east, distant twenty-nine miles, by the course of the river, from Tenasserim, or about sixty-five miles from Mergui; the distance in a direct line from Mergui is about twenty-eight miles in a west by south direction.

A small stream passes through the upper part of the coal bed, exposing part of a thick stratum of coal covered by three feet of clay slate, and from twenty to forty feet of sand.

The sand may be removed easily with any tool, but at the same time is so tenacious as to require no propping where springs do not exist, and the slate being only three feet thick shafts may be sunk with celerity and ease.

Whether the galleries will require propping is doubtful; but if so, abundance of timber for the purpose exists upon the spot.

Springs will certainly be met with at the level of the slate, but this must always be expected in a coal mine.

The Nulla is quite unfit for the conveyance of coal to the river, but, a level line of road may be formed with little expense.

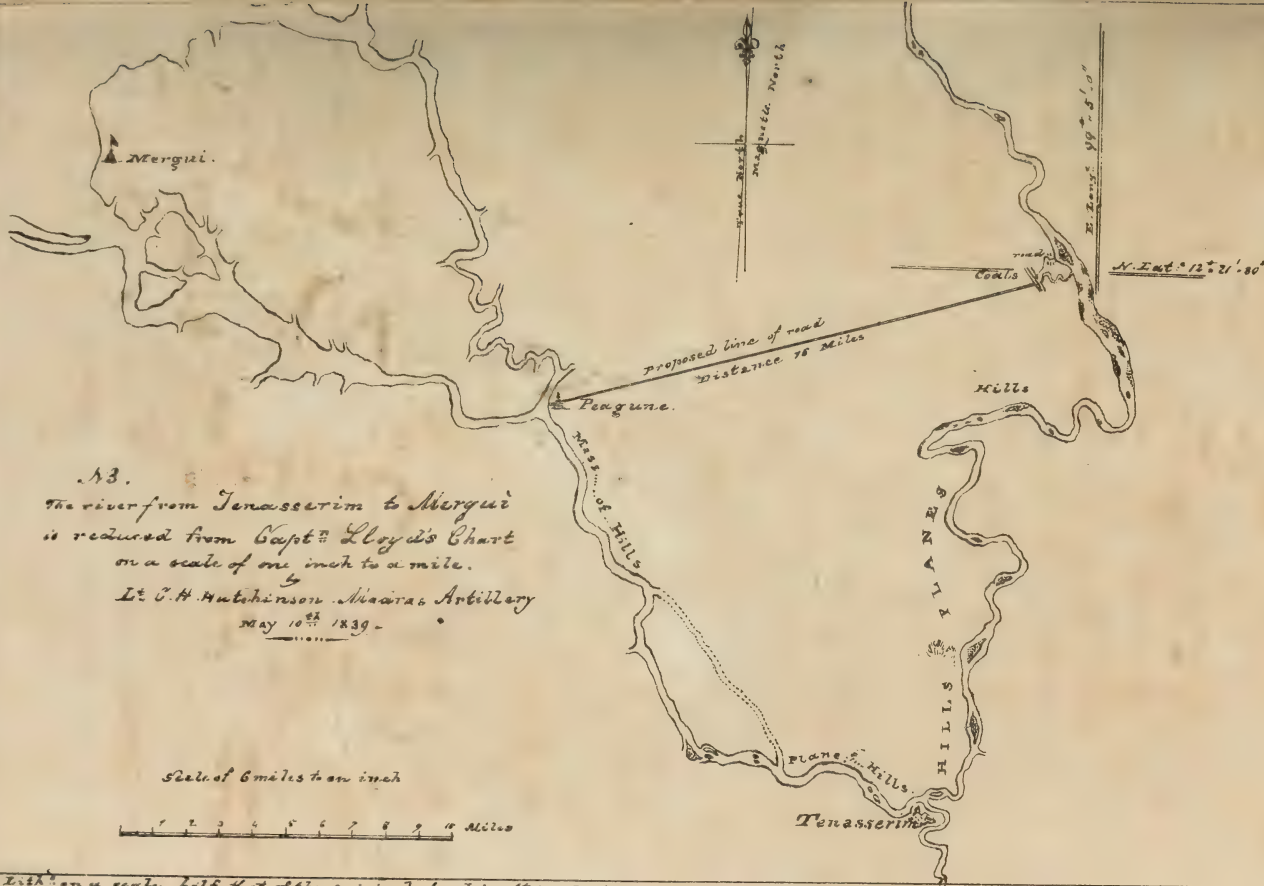
The coal is distant from the river about one mile.

The river may be ascended during the fine weather with an ordinary number of men to each boat, but the water is upwards of twenty feet higher during the rainy season, and it appears doubtful whether proper boats could be got up during that time, at any rate without the assistance of steam, or some adequate power.

The shallowest water at this time of the year (when it is lowest) is eighteen inches. The river is therefore navigable for boats drawing nine or twelve inches, and of thirty feet in length by ten in breadth, capable of carrying six or seven and a half tons.

Allowing one man to every ton of coal, four days will be required to bring the coal down to Mergui, and at least five to return with the boats; making the expense of actual transport one man's hire for nine days, or three Rupees per ton, exclusive of its carriage from the mine to the river.

Referring to the Chart, the question presents itself whether a line for a road could not be formed from the coal to some point near the place called Peagune. The country between this and Tenasserim is



13.

The river from Tenasserim to Mergui
is reduced from Capt. Lloyd's Chart
on a scale of one inch to a mile.

By Lt. J. H. Hutchinson, Madras Artillery
May 10th 1839.

Enl. on a scale, half that of the original, by Lieut. M. Keltor.

Oriental Lith. Press.



mountainous, but the ridges run in nearly the same direction as would the road, and from the numerous large nullas falling into the river near to Peagune it appears possible that a practicable line might be formed. The distance is only fifteen miles.

A tolerably level railway across this part of the country would reduce the expense of actual transport to Mergui to one man for four days to every one and a half tons of coal, or to nearly one Rupee per ton, supposing the carriage is to be drawn by men; but by employing ponies the price is reduced to less than four annas a ton. Now in case of delay and extra power being required in some parts of the line, take the expense at three times the estimate, or twelve annas per ton, which is still only a quarter of that incurred in the transport by water; thus being a saving of 22,500 Rupees in favor of the road upon the transport of 10,000 tons of coal.

The best description of road for this country appears to be a single suspension rail of timber (as represented by figures 1 to 4 in the enclosed sketch) as being cheapest in construction, uninjured by heavy rain, easily repaired, and (by actual experiment) offering less resistance to the motion of carriages than any other form of road. It consists of a plank of hard wood, three inches broad by ten or twelve deep, supported on posts nine or ten feet apart, and varying in length according to the surface of the country passed over, so as to support the rail in a horizontal line. The rail is let into a notch cut on the top of the posts, and is adjusted by means of wedges driven in opposite directions between the posts and the rail; the resistance is reduced thirty per cent. by the addition of a thin plate of iron upon the top of the rail. A carriage having only two wheels with the load suspended on either side is represented in figures 1, 2, 3.*

A road on this principle has been tried with great success in England. A horse was found capable of dragging fourteen tons, exclusive of the carriage, during a good day's work where the rail was quite level. Figure 4 shews the manner of crossing streams and small ravines.

I have no doubt but these carriages would run upon a cable stretched from point to point should circumstances require it.

Models can be furnished if required. I have, &c.

(Signed) C. H. HUTCHINSON,

MERGUI, 6th May, 1839.

2d Lieut. Madras Artillery.

(A true Copy.) E. A. BLUNDELL,

Commissioner in the Tenasserim Provinces.

* We have not received Lieut. Hutchinson's sketch, but his description is nevertheless sufficiently intelligible. The subject is of so much interest that we deem it ex-